National Transportation Safety Board
Aviation Accident Final Report

Location:	KAMUELA, HI	**Accident Number:**	LAX97LA088
Date & Time:	01/12/1997, 1026 HST	**Registration:**	N7012G
Aircraft:	McDonnell Douglas 369D	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	1 None
Flight Conducted Under:	Part 91: General Aviation - Positioning		

Analysis

The helicopter was being operated in a marine environment. The pilot reported he lost engine power during the initial takeoff climb and autorotated to an open field. The helicopter landed hard and the main rotor blades severed the tailboom. Examination of the engine fuel filter, the fuel control unit (FCU) screen, and the fuel nozzle screen revealed contamination in the fuel system. The helicopter had been inspected in accordance with the manufacturer's 100/300 hour inspection about 21.2 flight hours before the accident. There were no reports of the engine fuel filter bypassing or the fuel filter caution light illuminating. The manufacturer's inspection program does not require the inspection of the fuel screens at the 100 or 300 hour intervals. The airframe manufacturer's maintenance manual does indicate that a conditional inspection be performed after the fuel filter caution light has illuminated. Review of the conditional inspection procedures revealed the FCU screen is to be removed and cleaned; however, there is no requirement for the removal and cleaning of the nozzle screen, which is downstream of the FCU screen, before the part's 2,500 hour overhaul cycle.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: fuel system contamination resulting in a partial loss of power, and the failure of the pilot to maintain adequate rotor rpm to cushion the autorotative landing and prevent main rotor blade contact with the tailboom. Factors were the inadequacy of manufacturer's maintenance inspection procedures for aircraft operated in a marine environment.

Findings

Occurrence #1: LOSS OF ENGINE POWER(PARTIAL) - MECH FAILURE/MALF
Phase of Operation: TAKEOFF - INITIAL CLIMB

Findings
1. (C) FUEL SYSTEM - CONTAMINATION
2. (C) FUEL SYSTEM,NOZZLE - BLOCKED(PARTIAL)
3. (F) PROCEDURE INADEQUATE - MANUFACTURER
4. (F) INSUFFICIENT STANDARDS/REQUIREMENTS,MANUFACTURER - MANUFACTURER
5. (C) FLUID,FUEL - OBSTRUCTED
6. TURBOSHAFT ENGINE - OUTPUT LOW

Occurrence #2: FORCED LANDING
Phase of Operation: EMERGENCY LANDING AFTER TAKEOFF

Occurrence #3: HARD LANDING
Phase of Operation: LANDING - FLARE/TOUCHDOWN

Findings
7. TERRAIN CONDITION - GROUND
8. (C) AUTOROTATION - IMPROPER - PILOT IN COMMAND
9. (C) ROTOR RPM - NOT MAINTAINED - PILOT IN COMMAND

Factual Information

On January 12, 1997, at 1026 hours Hawaiian standard time, a McDonnell Douglas 369D, N7012G, landed hard after a loss of engine power about 1.5 miles north-northwest of the Waimea-Kohhala Airport, Kameula, Hawaii. The helicopter sustained substantial damage, and the certificated commercial pilot was not injured. The helicopter was being operated as a positioning flight under 14 CFR Part 91 by Imua Air Service when the accident occurred. Visual meteorological conditions prevailed at the time.

The pilot departed the operator's facility and had flown a distance of approximately 500 feet gaining about 150 feet in altitude when the power loss occurred. The pilot entered an autorotation and the helicopter landed in an open area. During touchdown the main rotor blades severed the tailboom. The pilot indicated to the Federal Aviation Administration (FAA) inspectors that the engine had continued to run at idle after the helicopter came to rest and that he manually shut it down.

Fuel Nozzle Examination

The helicopter was examined by inspectors from the FAA, who found the screen in the fuel nozzle collapsed and contaminated with debris. The engine fuel filter and the fuel control unit fuel screen were also examined and found contaminated.

The helicopter's engine fuel filter, fuel control unit screen, and fuel nozzle screen were sent by the FAA to the Safety Board for further examination. The fuel nozzle was tested on a fuel nozzle test stand at an FAA approved repair station. The spray pattern appeared streaked. The technician operating the stand pointed out that the nozzle shroud was worn beyond acceptable limits. The technician further stated that the wear was most likely caused by the shroud touching the engine combuster liner.

The fuel nozzle shroud was then measured using a electronic digital micrometer. The outside diameter of the shroud measured .62195 inches. The outside dimension of the worn area was .60685 inches. Fuel nozzle inspection criteria contained in the engine manufacturer's operation and maintenance manual indicates that nozzles exceeding .005 inches maximum wear on the outside dimension of the outer air shroud should be rejected.

Maintenance records indicated that the nozzle was last overhauled March 24, 1994, and installed on the accident helicopter engine on March 6, 1996. There was no record found indicating the nozzle was placed into service between the overhaul and installation in the helicopter. The nozzle had accumulated about 317.2 hours since the installation.

Filter/Screen Contamination Exam

The filters were examined by Safety Board investigators at the helicopter's airframe manufacturer's facilities in Mesa, Arizona, utilizing a scanning electron microscope (SEM). Electronic dispersive spectroscopy (EDS) data was collected to determine the elements present on the particles that were observed on the filters under high magnification.

The engine fuel filter, or main filter, was sectioned at one end, revealing a sand-like residue. Five particles of the residue were examined in the SEM. All five particles contained the same elements in the same proportions. The predominant element found was aluminum. The other elements included iron, sulfur, calcium, zinc, potassium, and traces of silicon, cadmium, and magnesium.

The fuel nozzle screen was removed from the nozzle. The screen was found clogged with debris and had collapsed. The screen was also examined in the SEM. The EDS data was then collected to determine the elements present in the debris. The predominant elements present were potassium, aluminum, and iron. Additional elements included magnesium, sulfur, calcium, zinc, silicon, copper, and nickel.

Fuel Control Unit Exam

The FCU screen was taken by the Safety Board to manufacturer's repair facility, which is also a FAA approved repair station, for testing. The FCU screen was placed in an exemplar FCU and tested. Differential pressure across the screen could not be determined because the FCU went into screen bypass. The exemplar fuel control unit was then tested without a filter to establish a base line. A new FCU screen, a random in-service screen with 2,500.1 hours, and the accident screen were then placed in the unit and blocked to prevent them from being bypassed.

The FCU was placed on a test bench and differential pressure checks were accomplished on all three screens utilizing manufacturer's test specifications. The tests revealed it took two to three times as much pressure for the accident FCU screen to obtain the same fluid flow as was obtained with the new and in-service screens. A copy of the test results are attached to this report.

Research

According to the airframe and engine manufacturers, the engine fuel filter and fuel control unit screens have a bypass feature. When the engine fuel filter bypasses, an advisory light is illuminated in the cockpit informing the pilot of the bypass condition. During the engine filter bypass, the contamination is allowed to flow to the fuel control unit (FCU) screen. Before the FCU screen becomes obstructed, it will bypass and allow the contamination to flow to the nozzle screen. There is no warning system associated with the FCU screen bypass and the pilot has no indication that the FCU screen bypass is occurring.

A review of the helicopter's maintenance records by the FAA revealed the helicopter had been inspected in accordance with the manufacturer's 100/300 hour on November 13, 1996, which was about 21.2 flight hours before the accident. There were no reports of the engine fuel filter bypassing or the fuel filter caution light illuminating.

The manufacturer's inspection program does not require the inspection of the fuel screens at the 100 or 300 hour intervals. The airframe manufacturer's maintenance manual does indicate that a conditional inspection be performed after the fuel filter caution light has illuminated. Review of the conditional inspection procedures outlined in the maintenance manual revealed the FCU screen is to be removed and cleaned. There is no requirement in the inspection procedures for the removal and cleaning of the nozzle screen, which is down stream of the FCU screen, before the part's 2,500 hour overhaul cycle.

Pilot Information

Certificate:	Commercial	**Age:**	37, Male
Airplane Rating(s):	None	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	Seatbelt, Shoulder harness
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Helicopter	**Toxicology Performed:**	No
Medical Certification:	Class 2 Valid Medical--no waivers/lim.	**Last FAA Medical Exam:**	01/07/1997
Occupational Pilot:		**Last Flight Review or Equivalent:**	
Flight Time:	9400 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	McDonnell Douglas	**Registration:**	N7012G
Model/Series:	369D 369D	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	510981D
Landing Gear Type:	High Skid	**Seats:**	5
Date/Type of Last Inspection:	11/13/1996, 100 Hour	**Certified Max Gross Wt.:**	2100 lbs
Time Since Last Inspection:	21 Hours	**Engines:**	1 Turbo Shaft
Airframe Total Time:	3804 Hours	**Engine Manufacturer:**	Allison
ELT:		**Engine Model/Series:**	250-C20B
Registered Owner:	IMUA AIR SERVICE	**Rated Power:**	420 hp
Operator:	IMUA AIR SERVICE	**Operating Certificate(s) Held:**	On-demand Air Taxi (135)
Operator Does Business As:		**Operator Designator Code:**	I6SL

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	ITO, 38 ft msl	**Distance from Accident Site:**	39 Nautical Miles
Observation Time:	0750 HST	**Direction from Accident Site:**	105°
Lowest Cloud Condition:	Clear / 0 ft agl	**Visibility**	10 Miles
Lowest Ceiling:	None / 0 ft agl	**Visibility (RVR):**	0 ft
Wind Speed/Gusts:	8 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	340°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30 inches Hg	**Temperature/Dew Point:**	25°C
Precipitation and Obscuration:			
Departure Point:		**Type of Flight Plan Filed:**	None
Destination:		**Type of Clearance:**	None
Departure Time:	0000	**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	N/A	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 None	**Latitude, Longitude:**	

Administrative Information

Investigator In Charge (IIC):	THOMAS H WILCOX	**Report Date:**	02/02/1998
Additional Participating Persons:	DARCY D REED; HONOLULU, HI		
Publish Date:			
Investigation Docket:	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov, or at 800-877-6799. Dockets released after this date are available at http://dms.ntsb.gov/pubdms/.		